NOAA SCIENTIFIC PUBLICATIONS REPORT
JUNE 19, 2017

HIGHLIGHTED ARTICLES

Persistent spatial structuring of coastal ocean acidification in the California Current System
Scientific Reports (5.228)

Exposure history determines pteropod vulnerability to ocean acidification along the US West Coast
Nature Scientific Reports (5.525)

A perfect storm: massive marine bird mortality caused by a dinoflagellate bloom in the Northeast Pacific
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Environmental conditions and prey-switching by a seabird predator impact juvenile salmon survival
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Advancing coastal ocean modelling, analysis, and prediction for the US Integrated Ocean Observing System
Journal of Operational Oceanography (3.342)

Collaborative efforts between the United States and United Kingdom to advance prediction of high-impact weather
Bulletin of the American Meteorological Society (11.808)

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OAR Publications

The ocean's vital skin
Frontiers in Marine Science (0.72)

A new interpretation of the ability of global models to simulate the MJO
Geophysical Research Letters (4.212)

Geological interpretation of volcanism and segmentation of the Mariana back-arc spreading center between 12.7°N and 18.3°N
Geochemistry, Geophysics, Geosystems (2.993)

Diets and growth of age-0 walleye in a recently recovered population
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NMFS Publications

Integrated ecological-economic fisheries models – Evaluation, review and challenges for implementation
Fish and Fisheries (8.258)

Altering vertical placement of hydroacoustic receivers for improved efficiency in cold water estuary zones
North American Journal of Fisheries Management (1.013)

Establishment of monosex female production of sablefish (*Anoplopoma fimbria*) through direct and indirect sex control
Aquaculture (1.893)

NESDIS Publications

Synthesis of public water supply use in the U.S.: Spatio-temporal patterns and socio-economic controls
Earth's Future (4.938)

Multidecadal variability and climate shift in the North Atlantic Ocean
Geophysical Research Letters (4.456)

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS

Atmospheric drivers of sea-level fluctuations and nuisance floods along the mid-Atlantic coast of the USA
NOAA Tech report

[Water clarity patterns in South Florida coastal waters and their linkages to synoptic-scale wind forcing]
NOAA Tech Report

HIGHLIGHTED ARTICLES

Persistent spatial structuring of coastal ocean acidification in the California Current System
Scientific Reports (5.228)
F. Chan, J. A. Barth, C. A. Blanchette, R. H. Byrne, F. Chavez, O. Cheriton, **R. A. Feely (OAR/PMEL)**, G. Friederich, B. Gaylord, T. Gouhier, S. Hacker, T. Hill, G. Hofmann, M. A. McManus, B. A. Menge, K. J. Nielsen, A. Russell, E. Sanford, J. Sevadjian, and L. Washburn

- A three-year survey of the California Current System along the West Coast of the United States found persistent, highly acidified water throughout this ecologically critical nearshore habitat, with "hotspots" of pH measurements as low as any oceanic surface waters in the world.
- There are "refuges" of more moderate pH environments that could become havens for some marine organisms to escape more highly acidified waters, and which could be used as a resource for ecosystem management.

The near-term progression of ocean acidification (OA) is projected to bring about sharp changes in the chemistry of coastal upwelling ecosystems. The distribution of OA exposure across these early-impact systems, however, is highly uncertain and limits our understanding of whether and how spatial management actions can be deployed to ameliorate future impacts. Through a novel coastal OA observing network, we have uncovered a remarkably persistent spatial mosaic in the penetration of acidified waters into ecologically important nearshore habitats across 1,000 km of the California Current Large Marine Ecosystem. In the most severe exposure hotspots, suboptimal conditions for calcifying organisms encompassed up to 56% of the summer season, and were accompanied by some of the lowest and most variable pH environments known for the surface ocean. Persistent refuge areas were also found, highlighting new opportunities for local adaptation to address the global challenge of OA in productive coastal systems.
Publication date: May 31, 2017
Available online: https://www.nature.com/articles/s41598-017-02777-y

Exposure history determines pteropod vulnerability to ocean acidification along the US West Coast

Nature Scientific Reports (5.525)

N. Bednaršek (OAR/PMEL), **R. A. Feely (OAR/PMEL), N. Tolimieri (NMFS/NWFSC)**, **A. J. Hermann (OAR/PMEL)**, S. A. Siedlecki, H. O. Pörtner, G. G. Waldbusser, **P. McElhany (NMFS/NWFSC)**, **S. R. Alin (OAR/PMEL)**, and J. Menkel

- Pteropods are frequently exposed to corrosive conditions along the US West Coast but little is known about their capacity to acclimatize to such conditions.
- Both exposure magnitude and duration were found to affect pteropod responses in the natural environment and pteropods showed no indication of acclimatization capacity or physiological tolerance related to history of exposure to corrosive conditions.
- Our results suggest that Pteropods from the coastal California Current Ecosystem appear to be at or near the limit of their physiological capacity, and consequently, are already at extinction risk under projected acceleration of OA over the next 30 years

The pteropod *Limacina helicina* frequently experiences seasonal exposure to corrosive conditions (Ω_{ar}<1) along the US West Coast and is recognized as one of the species most susceptible to ocean acidification (OA). Yet, little is known about their capacity to acclimatize to such conditions. We collected pteropods in the California Current Ecosystem (CCE) that differed in the severity of exposure to Ω_{ar} conditions in the natural environment. Combining field observations, high-CO_2 perturbation experiment results, and retrospective ocean transport simulations, we investigated biological responses based on histories of magnitude and duration of exposure to Ω_{ar}<1. Our results suggest that both exposure magnitude and duration affect pteropod responses in the natural environment. However, observed declines in calcification performance and survival probability under high CO_2 experimental conditions do not show acclimatization capacity or physiological tolerance related to history of exposure to corrosive conditions. Pteropods from the coastal CCE appear to be at or near the limit of their physiological capacity, and consequently, are already at extinction risk under projected acceleration of OA over the next 30 years. Our results demonstrate that Ω_{ar} exposure history largely determines pteropod response to experimental conditions and is essential to the interpretation of biological observations and experimental results.

A perfect storm: massive marine bird mortality caused by a dinoflagellate bloom in the Northeast Pacific

Marine Ecology Progress Series (2.361)

T. Jones, J. K. Parrish, A. E. Punt, **V. L. Trainer (NMFS/NWFSC)**, R. Kudela, J. Lang, M. Sue Brancato, A. Odell, B. M. Hickey

- In 2009, there was 10,500 marine bird carcasses found in Washington state due to the algal species, *Akashiwo sanguinea*.
- This study documents one of the largest marine bird mortality events definitely ascribed to harmful algal blooms.
- The environmental conditions that led to the harmful algal bloom coinciding with the aggregations of marine birds may become more prevalent in the future.

Harmful algal blooms (HABs) are dense concentrations of phytoplankton that collectively result in deleterious effects on marine life, often via the production of toxigenic or otherwise harmful compounds. We document one of the largest marine bird mortality events ever definitively ascribed to a HAB, the cause of which was death resulting from plumage fouling by surfactant-like proteins produced by *Akashiwo sanguinea*. Two distinct mortality events were observed along the coast of Washington State in September and October 2009, collectively representing an estimated deposition of 10,500 carcasses, of which the majority were Surf scoters, White-winged scoters and Common murres. Each mortality event was coincident in space and time with observed bloom landfall, with each event preceded by a similar chain of environmental conditions. Prior to each event, the presence of *A. sanguinea* and upwelling favourable conditions likely led to bloom proliferation. In both cases, this period was followed by conditions that transported the senescent bloom into the nearshore environment, whereupon subsequent wave action lysed *A. sanguinea* cells, creating foam that contained surfactant-like compounds. This sequence of conditions together with the presence of aggregations of marine birds with reduced flight capacity due to wing moult, are likely the necessary requirements for a marine bird mortality event of this scale due to foam-induced plumage fouling. This mechanism of HAB-induced mortality may become more prevalent in the California Current System given the apparent increasing occurrence of HABs, and the broad environmental tolerances exhibited by *A. sanguinea*.

Acceptance date: May 25, 2017

Environmental conditions and prey-switching by a seabird predator impact juvenile salmon survival
Journal of Marine Systems (2.476)
B. K. Wells, Jarrod A. Santora, M. J. Henderson, P. Warzybok, J. Jahncke, R. W. Bradley, **D. D. Huff (NMFS/NWFSC)**, I. D. Schroeder, P. Nelson, J. C. Field, D. G. Ainley

- Following optimal upwelling, murre disperse more offshore to forage on rockfishes.
- When rockfishes are unavailable, murre feed nearshore on northern anchovy.
- Predation on out-migrating juvenile salmon is greater when murre feed nearshore.
- Incidental predation on salmon inshore significantly reduces population survival.

Due to spatio-temporal variability of lower trophic-level productivity along the California Current ecosystem (CCE), predators must be capable of switching prey or foraging areas in response to changes in environmental conditions and available forage. The Gulf of the Farallones in central California represents a biodiversity hotspot and contains the largest common murre (Uria aalge) colonies along the CCE. During spring, one of the West Coast's most important Chinook salmon (Oncorhynchus tshawytscha) populations out-migrates into the Gulf of the Farallones. We quantify the effect of predation on juvenile Chinook salmon associated with ecosystem-level variability by integrating long-term time series of environmental conditions (upwelling, river discharge), forage species abundance within central CCE, and population size, at-sea distribution, and diet of the common murre. Our results demonstrate common murres typically forage in the vicinity of their offshore breeding sites, but in years in which their primary prey, pelagic young-of-year rockfish (Sebastes spp.), are less available they forage for adult northern anchovies (Engraulis mordax) nearshore. Incidentally, while foraging inshore, common murre consumption of out-migrating juvenile Chinook salmon, which are collocated with northern anchovy, increases and population survival of the salmon is significantly reduced. Results support earlier findings that show timing and strength of upwelling, and the resultant forage fish assemblage, is related to Chinook salmon recruitment variability in the CCE, but we extend those results by demonstrating the significance of top-down impacts associated with these bottom up dynamics. Our results demonstrate the complexity of ecosystem interactions and impacts between higher trophic-level predators and their prey, complexities necessary to quantify in order to parameterize ecosystem models and evaluate likely outcomes of ecosystem management options.
Acceptance date: 5/19/17

Available online:
http://www.sciencedirect.com/science/article/pii/S0924796317300866

CROSS LINE OFFICE ARTICLES

Advancing coastal ocean modelling, analysis, and prediction for the US Integrated Ocean Observing System
Journal of Operational Oceanography (3.342)
J. Wilkin, L. Rosenfeld, A. Allen, **R. Baltes (NOS/IOOS)**, A. Baptista, R. He, P. Hogan, A. Kurapov, **A. Mehra (NWS/NCEP)**, J. Quintrell, D. Schwab, R. Signell and J. Smith

- This work frames the strategic approaches to expand the current state and capabilities of coastal and ocean modeling to enhance the capabilities and capacity of Integrated Ocean Observing System (IOOS) observations and the system itself.
- This strategy was built by an interagency and multi-disciplinary group assembled by the Interagency Ocean Observing Committee (IOOC) after concluding a thorough analysis of the current capabilities of coastal modeling and making recommendations for advancement areas.
- The strategy outlines approaches to advance the system over 3-8 years and by promoting collaboration between regional, national, and international partners in the ocean research community.

This paper outlines strategies that would advance coastal ocean modeling, analysis and prediction as a complement to the observing and data management activities of the coastal components of the US Integrated Ocean Observing System (IOOS®) and the Global Ocean Observing System (GOOS). The views presented are the consensus of a group of US-based researchers with a cross-section of coastal oceanography and ocean modelling expertise and community representation drawn from Regional and US Federal partners in IOOS. Priorities for research and development are suggested that would enhance the value of IOOS observations through model-based synthesis, deliver better model-based information products, and assist the design, evaluation, and operation of the observing system itself. The proposed priorities are: model coupling, data assimilation, nearshore processes, cyberinfrastructure and model skill assessment, modelling for observing system design, evaluation and operation, ensemble prediction, and fast predictors. Approaches are suggested to accomplish substantial progress in a 3–8-year timeframe. In addition, the group proposes steps to promote collaboration between research and operations groups in Regional Associations, US Federal Agencies,

and the international ocean research community in general that would foster coordination on scientific and technical issues, and strengthen federal–academic partnerships benefiting IOOS stakeholders and end users.
Publication date: May 20, 2017
Available online: http://dx.doi.org/10.1080/1755876X.2017.1322026

Collaborative efforts between the United States and United Kingdom to advance prediction of high-impact weather
Bulletin of the American Meteorological Society (11.808)
J. S. Kain (OAR/NSSL), S. Willington, **A. J. Clark (OAR/NSSL)**, **S. J. Weiss (NWS/NCEP)**, M. Weeks, **I. L. Jirak (NWS/NCEP)**, **M. C. Coniglio (OAR/NSSL)**, N. M. Roberts, **C. D. Karstens (OAR/NSSL)**, J. M. Wilkinson, **K. H. Knopfmeier (OAR/NSSL)**, H. W. Lean, L. Ellam, K. Hanley, R. North, D. Suri

- The Met Office brought expertise gained from its efforts using convection-allowing models (CAMs) to better represent the convective storms that bring flash flooding in the United Kingdom.
- The infusion of Met Office models and perspectives dovetailed exceptionally well with the rapidly growing National Severe Storms Laboratory (NSSL) and Storm Prediction Center (SPC) proficiency in using CAMs to help predict tornadoes, large hail, and damaging winds.
- The successful collaborative efforts of the Hazardous Weather Testbed, NSSL, SPC, and Met Office are demonstrating that international collaboration can provide synergy, efficiency, and important scientific advances when it is strongly supported at both grassroots and institutional levels.

In recent years, a growing partnership has emerged between the Met Office and the designated U.S. national centers for expertise in severe weather research and forecasting, that is, the National Oceanic and Atmospheric Administration (NOAA) National Severe Storms Laboratory (NSSL) and the NOAA Storm Prediction Center (SPC). The driving force behind this partnership is a compelling set of mutual interests related to predicting and understanding high-impact weather and using high-resolution numerical weather prediction models as foundational tools to explore these interests.

The forum for this collaborative activity is the NOAA Hazardous Weather Testbed, where annual Spring Forecasting Experiments (SFEs) are conducted by NSSL and SPC. For the last decade, NSSL and SPC have used these experiments to find ways that high-resolution models can help achieve greater success in the prediction of tornadoes, large hail, and damaging winds. Beginning in 2012, the

Met Office became a contributing partner in annual SFEs, bringing complementary expertise in the use of convection-allowing models, derived in their case from a parallel decade long effort to use these models to advance prediction of flash floods associated with heavy thunderstorms.

The collaboration between NSSL, SPC, and the Met Office has been enthusiastic and productive, driven by strong mutual interests at a grassroots level and generous institutional support from the parent government agencies. In this article, a historical background is provided, motivations for collaborative activities are emphasized, and preliminary results are highlighted.
Publication date: May 15, 2017
Available online: http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-15-00199.1

ADDITIONAL ARTICLES

NOS Publications

The development of a non-linear autoregressive model with exogenous input (NARX) to model climate-water clarity relationships: reconstructing a historical water clarity index for the coastal waters of the southeastern USA
Theoretical and Applied Climatology (2.640)
C. C. Lee, S. C. Sheridan, B. B. Barnes, C. Hu, **D. E. Pirhalla, V. Ransibrahmanakul, K. Shein (NOS/NCCOS)**

- Water clarity, strongly affected by atmospheric events, is linked to substantial environmental impacts throughout the southeastern USA.
- A time series modeling technique revealed cyclonic circulation and transitional atmospheric situations coincide with turbid water, while stagnant, stable conditions lead to greater water clarity.
- Findings support long-term water clarity projections in MPAs.

The coastal waters of the southeastern USA contain important protected habitats and natural resources that are vulnerable to climate variability and singular weather events. Water clarity, strongly affected by atmospheric events, is linked to substantial environmental impacts throughout the region. To assess this relationship over the long-term, this study uses an artificial neural network-based time series modeling technique known as non-linear autoregressive models with exogenous input (NARX models) to explore the relationship between climate and a water clarity index (KDI) in this area and to reconstruct this index over a 66-year period. Results show that synoptic-scale circulation patterns, weather types, and precipitation all play roles in affecting water clarity to varying degrees in each region of the larger domain. In particular, turbid water is associated with

transitional weather and cyclonic circulation in much of the study region. Overall, NARX model performance also varies—regionally, seasonally and interannually—with wintertime estimates of KDI along the West Florida Shelf correlating to the actual KDI at $r > 0.70$. Periods of extreme (high) KDI in this area coincide with notable El Niño events. An upward trend in extreme KDI events from 1948 to 2013 is also present across much of the Florida Gulf coast.
Analyses of individual variable relationships to the KDI show that cyclonic circulation and transitional atmospheric situations coincide with turbid water, while stagnant, stable conditions lead to greater water clarity. A novel modeling methodology using an ensemble of non-linear autoregressive models with external input (NARX models) allowed for a 66-year reconstruction of the KDI in each region.
Publication date: August 25, 2016
Available online: https://link.springer.com/article/10.1007/s00704-016-1906-7

OAR Publications

The ocean's vital skin
Frontiers in Marine Science
A. Engel, H. W. Bange, M. Cunliffe, S. M. Burrows, G. Friedrichs, L. Galgani, H. Herrmann, N. Hertkorn, M. Johnson, P. Liss, **P. K. Quinn (OAR/PMEL)**, M. Schartau, A. Soloviev, C. Stolle, R. Upstill-Goddard, M. van Pinxteren, and B. Zäencker

- This review identifies gaps in our current knowledge of the sea surface microlayer.
- This review highlights a need to develop a holistic and mechanistic understanding of the diverse biological, chemical and physical processes occurring at the ocean-atmosphere interface.

Despite the huge extent of the ocean's surface, until now relatively little attention has been paid to the sea surface microlayer (SML) as the ultimate interface where heat, momentum and mass exchange between the ocean and the atmosphere takes place. Via the SML, large-scale environmental changes in the ocean such as warming, acidification, deoxygenation and eutrophication potentially influence cloud formation, precipitation and the global radiation balance. Due to the deep connectivity between biological, chemical and physical processes, studies of the SML may reveal multiple sensitivities to global and regional changes. Understanding the processes at the ocean's surface, in particular involving the SML as an important and determinant interface, could therefore provide an essential contribution to the reduction of uncertainties regarding ocean-climate feedbacks. This review identifies gaps in our current knowledge of the SML and

highlights a need to develop a holistic and mechanistic understanding of the diverse biological, chemical and physical processes occurring at the ocean-atmosphere interface. We advocate the development of strong interdisciplinary expertise and collaboration in order to bridge between ocean and atmospheric sciences. Although this will pose significant methodological challenges, such an initiative would represent a new role model for interdisciplinary research in Earth System sciences.
Publication date: May 30, 2017
Available online:
http://journal.frontiersin.org/article/10.3389/fmars.2017.00165/full

A new interpretation of the ability of global models to simulate the MJO
Geophysical Research Letters (4.212)
J. Ling, **C. Zhang (OAR/PMEL)**, S. Wang, and C. Li

- All 27 simulations produced large-scale eastward propagating signals in precipitation (the Madden Julian Oscillation; MJO) but with different occurrence frequencies
- There is no statistically significant distinction in the strength and propagation speeds of MJO events simulated by most of these models
- It is hypothesized that a model can produce the MJO only in a particular background state

Statistical diagnostics have led to a common perception that only few global models can reproduce the Madden Julian Oscillation (MJO). Here we demonstrate, using a method of tracking individual MJO events, that this perception is incorrect. Of 27 global model simulations diagnosed, all produced large-scale slowly eastward propagating signals in precipitation, which are taken as manifestations of the MJO. The difference is some model produced them frequently, others infrequently. There is no statistically significant distinction between the strength and propagation speeds of MJO events produced by most of these models. A hypothesis is proposed to interpret our results: A model can produce the MJO only in a particular background state. If the background state of a model can be constantly in a condition that is conducive to its production of the MJO, this model simulates the MJO frequently. If not, this model can still produce the MJO but only infrequently when its seasonal background state occasionally migrates into a condition that is conducive to its production of the MJO. Preliminary results from testing this hypothesis are presented.
Publication date: June 12, 2017
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2017GL073891/epdf

Geological interpretation of volcanism and segmentation of the Mariana back-arc spreading center between 12.7°N and 18.3°N
Geochemistry, Geophysics, Geosystems (2.993)
M. O. Anderson, **W. W. Chadwick**, M. D. Hannington, **S. G. Merle , J. A. Resing, E. T. Baker, D. A. Butterfield, S. L. Walker (OAR/PMEL)**, and N. Augustin

- Ridge segmentation is controlled by pre-existing basement structures Spreading is perpendicular to the back-arc axis, allowing precise spreading directions to be determined.
- Segment morphology reflects magma supply, which is locally enhanced by proximity to cross-arc volcanoes.

The relationships between tectonic processes, magmatism, and hydrothermal venting along ~600 km of the slow-spreading Mariana back-arc between 12.7°N and 18.3°N reveal a number of similarities and differences compared to slow-spreading mid-ocean ridges. Analysis of the volcanic geomorphology and structure highlights the complexity of the back-arc spreading center. Here, ridge segmentation is controlled by large-scale basement structures that appear to pre-date back-arc rifting. These structures also control the orientation of the chains of cross-arc volcanoes that characterize this region. Segment-scale faulting is oriented perpendicular to the spreading direction, allowing precise spreading directions to be determined. Four morphologically-distinct segment types are identified: dominantly magmatic segments (Type I); magmatic segments currently undergoing tectonic extension (Type II); dominantly tectonic segments (Type III); and tectonic segments currently undergoing magmatic extension (Type IV). Variations in axial morphology (including eruption styles, neovolcanic eruption volumes, and faulting) reflect magma supply, which is locally enhanced by cross-arc volcanism associated with N-S compression along the 16.5°N and 17.0°N segments. In contrast, cross-arc seismicity is associated with N-S extension and increased faulting along the 14.5°N segment, with structures that are interpreted to be oceanic core complexes—the first with high-resolution bathymetry described in an active back-arc basin. Hydrothermal venting associated with recent magmatism has been discovered along all segment types.
Publication date: May 23, 2017
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2017GC006813/full

Diets and growth of age-0 walleye in a recently recovered population
Journal of Great Lakes Research (1.910)
S. R. Stein, C. R. Roswell, **S. A. Pothoven (OAR/GLERL)**, T. O. Höök

- Young (larval and later-stage young of year) walleye were collected from Saginaw Bay and their growth, diets, and cumulative consumption were characterized using bioenergetics models.
- Age-0 walleye have recovered in Saginaw Bay, but their growth depends on consumption of invasive prey including gobies and smelt.

Most fishes undergo ontogenetic diet shifts, progressing from small to larger prey as they grow. The availability of suitable prey throughout early ontogeny can influence growth, survival and ultimately, year-class strength. Simultaneously, due to their numeric abundance and high mass-specific consumption rates, young fish can serve as influential consumers and thereby affect abundance of various prey. The walleye Sander vitreus population in Saginaw Bay, Lake Huron, recently recovered and is now entirely supported by natural reproduction. Recovery coincided with a dramatic decline of alewife Alosa pseudoharengus, a preferred prey of walleye. Thus, we are uncertain what primary prey now support production of young life stages of this recovered walleye population. To this end, we collected young (larval and later-stage young of year) walleye in Saginaw Bay and characterized their growth, diets and cumulative consumption using bioenergetics models. Young walleye progressed from feeding entirely on zooplankton as larvae in April to feeding almost entirely on fish by September. Based on bioenergetics analyses, fish were the most important prey for young walleye cohorts. Shiners Notropis spp., along with invasive rainbow smelt Osmerus mordax and round goby Neogobius melanostomus, were the primary fish prey. In contrast, yellow perch Perca flavescens, an important prey for adult walleye in Saginaw Bay, were largely absent in young walleye diets. Young walleye growth rates were similar to rates observed in other systems, but lower than growth rates previously observed in Saginaw Bay when alewife were abundant and the density of walleye was low.
Publication date: April 8, 2017
Available online:
http://www.sciencedirect.com/science/article/pii/S0380133017300606

NMFS Publications

Integrated ecological-economic fisheries models – Evaluation, review and challenges for implementation

Fish and Fisheries (8.258)

J. R. Nielsen, **E. Thunberg (NMFS/NEFSC)**, **D. Holland (NMFS/NWFSC)**, J. O. Schmidt, E. A. Fulton, F. Bastardie, A. E. Punt, I. Allen, H. Bartelings, M. Bertignac, E. Bethke, S. Bossier, R. Buckworth, G. Carpenter, A. Christensen, V. Christensen, J. M. Da-Rocha, R. Deng, C. M. Dichmont, R. Doering, A. Esteban, J. A. Fernandes, H. Frost, D. Garcia, L. Gasche, D. Gascuel, S. Gourguet, R. A. Groeneveld, J. Guillen, O. Guyader, K. G. Hamon, A. Hoff, J. Horbowy, T. Hutton, S. Lehuta, L. R. Little, J. Lleonart, C. Macher, S. Mackinson, S. Mahevas, P. Marchal, R. Mato-Amboage, B. Mapstone, F. Maynou, M. Merzéréaud, A. Palacz, S. Pascoe, A. Paulrud, E. Plaganyi, R. Prellezo, E. I. van Putten, M. Quaas, L. Ravn-Jonsen, S. Sanchez, S. Simons, O. Thébaud, M. T. Tomczak, C. Ulrich, D. Van Dijk, Y. Vermard, R. Voss, S. Waldo.

- Marine resources managers must balance diverse and often competing interests, all while making decisions about highly complex systems with limited and imprecise knowledge.
- Integrated economic-ecological models can provide managers with a better and more explicit understanding of how natural and human processes interact to influence outcomes, focusing on incorporating feedbacks between the environmental and human processes.
- Modelers need to be willing to invest time into creating user friendly coupled economic-ecological models or make a longterm commitment to direct, repeated participation in management for models and results to be explained and discussed.

Marine ecosystems evolve under many interconnected and area-specific pressures. In order to fulfill society's intensifying and diversifying needs whilst ensuring ecologically sustainable development, more effective marine spatial planning and broader-scope management of marine resources is necessary. Integrated ecological–economic fisheries models (IEEFMs) of marine systems are needed to evaluate impacts and sustainability of potential management actions and understand, and anticipate ecological, economic, and social dynamics at a range of scales from local to national and regional. To make these models most effective, it is important to determine how model characteristics and methods of communicating results influence the model implementation, the nature of the advice that can be provided and the impact on decisions taken by managers. This paper presents a global review and comparative evaluation of 35 IEEFMs applied to marine fisheries and marine ecosystem resources to identify the characteristics

that determine their usefulness, effectiveness and implementation. The focus is on fully integrated models that allow for feedbacks between ecological and human processes though not all the models reviewed achieve that. Modelers must invest more time to make models user friendly and to participate in management fora where models and model results can be explained and discussed. Such involvement is beneficial to all parties, leading to improvement of models and more effective implementation of advice, but demand substantial resources which must be built into the governance process. It takes time to develop effective processes for using IEEFMs requiring a long-term commitment to integrating multidisciplinary modeling advice into management decision making.
Acceptance date: May 2, 2017

Altering vertical placement of hydroacoustic receivers for improved efficiency in cold water estuary zones
North American Journal of Fisheries Management (1.013)
G. S. Goulette, **J. P. Hawkes (NMFS/NEFSC)**

- Assessed influence of acoustic receiver depth on detection efficiency for Atlantic salmon (*Salmo salar*).
- Increasing depth led to improved detection efficiency of transmitters.
- Improvements in efficiency of acoustic telemetry arrays to better support research studies.

Acoustic telemetry is used to study Atlantic Salmon *Salmo salar* migration ecology and identify mortality zones within estuary systems. Improved detection efficiency helps reduce the uncertainty associated with survival estimates and improves the accuracy of various migration performance metrics. While emigrating smolts and post-smolts are largely surface-oriented, using the top few meters of the water column, literature suggests they may sound to 10 m or deeper, influencing detection probability and therefore survival estimates. We determined the influence of receiver depth on detection efficiency to improve telemetry assessments in our cold water estuary zones. We found significant differences in total detections with experimental depths. Detection efficiency of transmitters improved as much as 18.3% when receivers were placed on bottom and by 9.2% when receivers were placed at 20 m versus 10 m depth. In a second portion of our study, we evaluated the influence of depth and several environmental variables on detection efficiency using sentinel transmitters. Receivers placed at 20 m depth had greater detection efficiencies than receivers placed at 10 m depth during increased precipitation and wind speed events and at all tide stages. Our results can be used to improve detection efficiency of surface-oriented species in cold-water estuary zones.
Acceptance date: May 24, 2017

Establishment of monosex female production of sablefish (Anoplopoma fimbria) *through direct and indirect sex control*
Aquaculture (1.893)
A. Luckenbach, W. T. Fairgrieve, E. S. Hayman (NMFS/NWFSC)

- Demonstrates for the first time that female sablefish significantly outgrow males in aquaculture.
- Establishes methods for monosex female production of sablefish for aquaculture.
- Conclusively establishes that sablefish exhibit XX/XY sex determination, similar to humans

Methods are needed for monosex production of sablefish (Anoplopoma fimbria) to capitalize on superior growth of females relative to males. This study aimed to characterize the system of sex determination and establish methods for both direct and indirect feminization of sablefish. Juvenile sablefish ~ 40 mm fork length were fed diets containing 17β-estradiol (E2), 17α-methyltestosterone (MT), or ethanol vehicle alone (control) for 2 months and then divided into subgroups either shifted to the control diet (E2- and MT-short (S) duration treatments) or maintained on steroid-treated diets for an additional 2 months (E2- and MT-long (L) duration treatments). Fish were subsampled for gonadal histology at the midpoint and end of the dietary treatments and all remaining fish were individually tagged to monitor subsequent growth and gonadal development for 36 months (post-treatment time points of 0, 4, 16, 24, and 36 months). Control fish exhibited balanced (1:1) sex ratios. E2 treatment regardless of duration induced ovarian differentiation in 100% of the genotypic males (i.e., direct feminization), while only the MT-L treatment induced testicular differentiation in 100% of the genotypic females (i.e., generating "neomales"). A high proportion (89%) of MT-S genotypic females possessed intersex gonads, indicating short-term MT exposure was insufficient to induce complete sex reversal. Significant differences in sex-specific growth were apparent by 16 months post-treatment and associated with gonadal phenotype; sablefish with ovaries outgrew those with testes, regardless of genotypic sex. Fish from the E2-S and -L and MT-L treatment groups maintained their respective feminized and masculinized states after steroid withdrawal, although MT-S treated genotypic females tended to show further masculinization post-treatment. Upon reaching sexual maturity, control males and neomales were crossed with wild-caught female broodstock. Resultant embryos from control crosses were 54.6 ± 8.9% (mean ± SD) genotypic female, while those from neomale-female crosses were 100 ± 0.0% genotypic female. Following sex differentiation, gonadal histology demonstrated that offspring from control crosses had a balanced phenotypic sex ratio, whereas

100% of neomale offspring developed normal ovaries. This study establishes that sablefish utilize an XX/XY system of sex determination and methods for both direct and indirect monosex female production.
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Availabe online:
http://www.sciencedirect.com/science/article/pii/S0044848617306361

NESDIS Publications

Synthesis of public water supply use in the U.S.: Spatio-temporal patterns and socio-economic controls
Earth's Future (4.938)
A. Sankarasubramanian, J. L. Sabo, K.L. Larson, T. Sinha, R. Bhowmik, A. R. Vidal, **K. Kunkel (NESDIS/NCEI)**, G. Mahinthakumar, E.Z. Berglund, and J. Kominoski

- Water-use efficiency is increasing in northern portions of the country while decreasing in southern portions.
- A county level analysis indicates that urban counties are becoming more efficient while rural counties are becoming less efficient. Investment in new water-efficiency technologies and retrofitting existing water infrastructure are big reasons for the improvement in urban areas.
- These findings underscore the value of focusing on efficiency measures – and the need to pursue those measures in rural counties- as strategies to insure water security in the face of climate change.

Recent USGS water use report suggests that increasing water-use efficiency could mitigate the supply-and-demand imbalance arising from changing climate and growing population. However, this rich data has not been analyzed to understand the underlying patterns, nor have been investigated to identify the factors contributing to this increased efficiency. A national-scale synthesis of public supply withdrawals reveals a strong North-South gradient in public supply water use with the increasing population in the South contributing to increased withdrawal. Contrastingly, a reverse South-North gradient exists in per-capita withdrawals (efficiency), with northern states consistently improving the efficiency, while the southern states' efficiency declined. Our analyses of spatial patterns of per-capita withdrawals further demonstrate that urban counties exhibit improved efficiency over rural counties. Improved efficiency is also demonstrated over high-income and well-educated counties. Given the potential implications of the findings in developing long-term water, conservation measures (i.e. increasing block rates), we argue the need for frequent updates, perhaps monthly to annual, of

water use data for identifying effective strategies that control the water-use efficiency in various geographic settings under a changing climate.
Publication date: May 18, 2017
Available online:
http://onlinelibrary.wiley.com/doi/10.1002/2016EF000511/abstract

Multidecadal variability and climate shift in the North Atlantic Ocean
Geophysical Research Letters (4.456)
D. Seidov, A. Mishonov, J. Reagan, R. Parsons (NESDIS/NCEI)

- Decadal variability of ocean heat content (OHC) and temperature trends over ~60 years in the North Atlantic Ocean were analyzed using a new high-resolution ocean climatology based on quality-controlled historic in situ observations.
- Climate shift in the North Atlantic is very inhomogeneous and concentrates in the Gulf Stream vicinity. The ocean climate change in the North Atlantic correlates with the Atlantic Multidecadal Oscillation. The warming in the south-western sector of the North Atlantic is at least partly caused by heaving of the warm subtropical water.
- Sheds new light on OHC decadal variability that is important for oceanographic community, especially for modeling climate and ocean change.

Multidecadal variability and climate shift in the North Atlantic Ocean
Abstract from paper: Decadal variability of ocean heat content (OHC) and temperature trends over ~60 years in the North Atlantic Ocean were analyzed using a new high-resolution ocean climatology based on quality-controlled historic in situ observations. Two ~30-year ocean climates of 1955–1984 and 1985–2012 were compared to evaluate the climate shift in this region. The spatial distribution of the OHC climate shift is highly inhomogeneous, with the climate shift being the strongest southeast of the Gulf Stream Extension. This may be caused by the Atlantic Meridional Overturning Circulation slowdown in conjunction with heaving of warm subtropical water. The 30-year climate shift shows higher OHC gain in the Gulf Stream region than reported in shorter timescale estimates. The OHC change is generally coherent with the Atlantic Multidecadal Oscillation index. This coherence suggests that quasi-cyclicity of the OHC may exist, with a period of 60 to 80 years, superimposed on the slow basin-wide warming trend. Important conclusions: Climate shift in the North Atlantic is very inhomogeneous and concentrates in the Gulf Stream vicinity. The ocean climate change in the North Atlantic correlates with the Atlantic Multidecadal Oscillation. The warming

in the south-western sector of the North Atlantic is at least partly caused by heaving of the warm subtropical water.
Publication date: May 21, 2017
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http://onlinelibrary.wiley.com/doi/10.1002/2017GL073644/abstract

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS PUBLICATIONS

Atmospheric drivers of sea-level fluctuations and nuisance floods along the mid-Atlantic coast of the USA
NOAA Tech report
S.C. Sheridan, **D. E. Pirhalla,** C. C. Lee, **V. Ransibrahmanakul (NOS/NCCOS)**

- Seasonal Outlooks of nuisance floods along Eastern Seaboard
- Show manifestations of some well-established factors in terms of short-term changes of sea level, namely, the inverted barometer effect as is manifested in the surface pressure patterns, and surface wind forcing as is depicted in the relative cyclonicity of the pressure fields.
- Analysis of the pattern transitions suggest that rapidly deepening cyclones, or persistent onshore flow, can be associated with the greatest likelihood of nuisance floods.

As sea levels have risen and continue to rise, the risk of coastal flooding has increased in turn. While many studies have examined specific extreme flooding events, far fewer have explored the systematic associations between weather events and smaller, nuisance flood events. In this research, we take a synoptic climatological approach to assess this connection. We utilize self-organizing maps (SOMs) to separately cluster two atmospheric fields, sea-level pressure and 700-hPa geopotential height. We then utilize the output from these classifications to assess the impact of atmospheric conditions on the short-term fluctuations of sea level for the period 1979-2012, as well as the likelihood of nuisance flood occurrence, at five tidal gauges from Cape May, NJ to Charleston, SC, along the mid-Atlantic coast of the US. Results show the impacts of both the inverted barometer effect as well as surface wind forcing. Beyond this, the SOM nodes show a clear spatial continuum of associations between circulation and anomalous sea level, including some significant sea level anomalies associated with relatively ambiguous pressure patterns. Moreover, the transitions from one day to the next are also analyzed, with results showing that rapidly deepening cyclones, or persistent onshore flow, can be associated with the greatest likelihood of nuisance floods. Results are generally weaker with 700-hPa height than sea-level pressure;

however, in some cases it is clear that the mid-tropospheric circulation can modulate the connection between sea-level anomalies and surface circulation.
Publication Date: April 24, 2017
Available Online: https://link.springer.com/article/10.1007/s10113-017-1156-y

Water clarity patterns in South Florida coastal waters and their linkages to synoptic-scale wind forcing
NOAA Tech Report
D. E. Pirhalla, S. C. Sheridan, C. C. Lee, B. B. Barnes, **V. Ransibrahmanakul (NOS/NCCOS)**, C. Hu

- Defined characteristics of water clarity for South Florida and identified key wind nodes and patterns that showed a strong association with elevated Kd and Kd index values.
- The Self Organizing Map (SOM)-based methods presented provided unprecedented resolution to the key synoptic-scale influence of winds on water clarity.
- The specific wind patterns borne out of synoptic climatological methods can be used to develop precursory early warning signals for water clarity events, especially considering the lagged effect of WPs on the days preceding these events.

Temporal variability in water clarity for South Florida's marine ecosystems was examined through satellite-derived light attenuation (Kd) coefficients, in the context of wind- and weather patterns. Reduced water clarity along Florida's coasts is often the result of abrupt wind-resuspension events and other exogenous factors linked to frontal passage, storms, and precipitation. Kd data between 1998 and 2013 were synthesized to form a normalized Kd index (KDI) and subsequently compared with Self Organizing Map (SOM)-based wind field categorizations to reveal spatiotemporal patterns and their inter-relationships. Kd climatological maximums occur from October through December along southern sections of the West Florida Shelf (WFS) and from January through March along the Florida Straits. Spatial clusters of elevated Kd occur along 3 spatial domains: central WFS, southern WFS, and Florida Straits near the Florida Reef Tract, where intra-seasonal variability is the highest, and clarity patterns are associated with transitional wind patterns sequenced with cyclonic circulation. Temporal wind transitions from southerly to northerly, typically accompanying frontal passages, most often result in elevated Kd response. Results demonstrate the potential of using synoptic climatological analysis and satellite indices for tracking variability in water clarity and other indicators related to biological health.
Publication date: October 2016

Available online: http://ojs.whioce.com/index.php/som/article/view/189